

We claim:

1. A method for establishing a label switched path for forwarding a packet with a label stack in a communication network, the communication network including a first label switched domain and a second label switched domain interconnected by a non-label switched domain, the method comprising:

establishing a tunnel across the non-label switched domain which connects the first label switched domain and the second label switched domain;  
encapsulating the packet and label stack to form a tunnel packet; and  
forwarding the tunnel packet through the tunnel.

2. A method according to claim 1, wherein establishing a tunnel includes mapping a top label of the label stack to the tunnel.

3. A method according to claim 1, wherein the tunnel is an IP tunnel.

4. A method according to claim 3, wherein the IP tunnel is a Generic Routing Encapsulation (GRE) tunnel.

5. A method according to claim 4, wherein encapsulating the packet and label stack information includes providing a label switching protocol identifier such that the second label switched domain may identify the packet and label stack.

6. A method according to claim 1, wherein the first label switched domain is a Multiprotocol Label Switching (MPLS) domain.

7. A method according to claim 1, wherein the second label switched domain is a Multiprotocol Label Switching (MPLS) domain.

8. A method according to claim 1, wherein the first label switched domain is a MPLS domain and the second label switched domain is a MPLS domain.

9. A method according to claim 8, wherein encapsulating the packet and label stack information includes providing an MPLS identifier in the tunnel packet such that the second label switched domain may identify the packet and label stack.

5 10. A device for establishing a label switched path for forwarding a packet with a label stack in a communication network, the communication network including a first label switched domain and a second label switched domain interconnected by a non-label switched domain, the device comprising:

label switching forwarding logic for identifying the next hop for the packet;

10 encapsulating logic for encapsulating the packet and label stack information to form a tunnel packet and for establishing a tunnel across the non-label switched domain which connects the first label switched domain and the second label switched domain; and

forwarding logic for forwarding the tunnel packet through the tunnel.

11. A device according to claim 10, wherein the label switching forwarding logic includes mapping logic for mapping a top label of the label stack to the tunnel.

12. A device according to claim 10, wherein the tunnel is an IP tunnel.

13. A device according to claim 12, wherein the IP tunnel is a Generic Routing Encapsulation (GRE) tunnel.

14. A device according to claim 13, wherein the tunnel packet includes a label switching protocol identifier such that the second label switched domain can identify the packet and  
25 label stack.

15. A device according to claim 10, wherein the first label switched domain is a Multiprotocol Label Switching (MPLS) domain.

30 16. A device according to claim 10, wherein the second label switched domain is a Multiprotocol Label Switching (MPLS) domain.

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17. A device according to claim 10, wherein the first label switched domain is a MPLS domain and the second label switched domain is a MPLS domain.

18. A device according to claim 17, wherein the tunnel packet includes an MPLS identifier such that the second label switched domain may identify the packet and label stack.

19. A computer program product for use on a computer system for establishing a label switched path for forwarding a packet with a label stack in a communication network, the communication network including a first label switched domain and a second label switched domain interconnected by a non-label switched domain, the computer program product comprising a computer usable medium having computer readable program code thereon, the computer readable program code including:

program code for establishing an IP tunnel across the non-label switched domain which connects the first label switched domain and the second label switched domain;

program code for encapsulating the packet and label stack information to form a tunnel packet; and

program code for forwarding the tunnel packet through the tunnel.

20. A computer program product according to claim 19, further including program code for mapping a top label of the label stack to the tunnel.

21. A computer program product according to claim 19, wherein the tunnel is an IP tunnel.

22. A computer program product according to claim 21, wherein the IP tunnel is a Generic Routing Encapsulation (GRE) tunnel.

23. A computer program product according to claim 22, further including program code for providing a label switching protocol identifier in the tunnel packet such that the second label switched domain may identify the packet and label stack.

24. A computer program product according to claim 19, wherein the first label switched

domain is a Multiprotocol Label Switching (MPLS) domain.

25. A computer program product according to claim 19, wherein the second label switched domain is a Multiprotocol Label Switching (MPLS) domain.

26. A computer program product according to claim 19, wherein the first label switched domain is a MPLS domain and the second label switched domain is a MPLS domain.

27. A computer program product according to claim 26, further including program code for providing an MPLS identifier in the tunnel packet such that the second label switched domain may identify the packet and label stack.

28. A method for establishing a label switched path for forwarding a packet with a label stack in a communication network, the communication network including a first label switched domain and a second label switched domain interconnected by a non-label switched domain, the method comprising:

establishing a tunnel across the non-label switched domain which connects the first label switched domain and the second label switched domain;

receiving a tunnel packet from the tunnel, the tunnel packet comprised of an encapsulated packet and label stack;

decapsulating the encapsulated packet and label stack; and

forwarding the decapsulated packet and label stack across the second label switched domain.

29. A method according to claim 28, wherein the first label switched domain is a MPLS domain and the second label switched domain is a MPLS domain.

30. A method according to claim 28, wherein the tunnel is an IP tunnel.

31. A method according to claim 30, wherein the IP tunnel is a Generic Routing Encapsulation (GRE) tunnel.

32. A method according to claim 28, wherein the tunnel packet includes a label switching protocol identifier such that the second label switched domain may identify the packet and label stack.

5 33. A method according to claim 29, wherein the tunnel packet includes a MPLS identifier such that the second label switched domain may identify the packet and label stack.

34. A device for establishing a label switched path for forwarding a packet with a label stack in a communication network, the communication network including a first label switched domain and a second label switched domain interconnected by a non-label switched domain, the device comprising:

10 receiving logic for receiving a tunnel packet from a tunnel across the non-label switched domain which connects the first label switched domain and the second label switched domain, the tunnel packet comprised of an encapsulated packet and label stack;  
decapsulating logic for decapsulating the encapsulated packet and label stack; and  
forwarding logic for forwarding the decapsulated packet and label stack across the second label switched domain.

35. A device according to claim 34, wherein the tunnel is an IP tunnel.

36. A device according to claim 35, wherein the IP tunnel is a Generic Routing Encapsulation (GRE) tunnel.

37. A device according to claim 34, wherein the first label switched domain is an MPLS domain and the second label switched domain is a MPLS domain.

38. A device according to claim 34, wherein the tunnel packet includes a label switching protocol identifier such that the second label switched domain may identify the packet and label stack.

39. A device according to claim 37, wherein the tunnel packet includes a MPLS identifier such that the second label switched domain may identify the packet and label stack.

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40. A computer program product for use on a computer system for establishing a label switched path for forwarding a packet with a label stack in a communication network, the communication network including a first label switched domain and a second label switched domain interconnected by a non-label switched domain, the device comprising:, the computer program product comprising a computer useable medium having computer readable program code thereon, the computer readable program code including:

program code for establishing a tunnel across the non-label switched domain which connects the first label switched domain and the second label switched domain;

program code for receiving a tunnel packet from the tunnel, the tunnel packet comprised of an encapsulated packet and label stack;

program code for decapsulating the encapsulated packet and label stack; and

program code for forwarding the decapsulated packet and label stack across the second label switched domain.

41. A computer program product according to claim 40, wherein the tunnel is an IP tunnel.

42. A computer program product according to claim 41, wherein the IP tunnel is a Generic Routing Encapsulation (GRE) tunnel.

43. A computer program product according to claim 40, wherein the first label switched domain is a MPLS domain and the second label switched domain is a MPLS domain.

44. A computer program product according to claim 40, wherein tunnel packet includes a label switching protocol identifier such that the second label switched domain may identify the packet and label stack.

45. A computer program product according to claim 43, wherein the tunnel packet includes a MPLS identifier such that the second label switched domain may identify the packet and label stack.

46. In a communication system having a first label switched domain interconnected with a second label switched domain by a non-label switched domain, a method for forwarding a label switched packet from the first label switched domain to the second label switched domain, the method comprising:

5 establishing a tunnel from an egress device of the first label switched domain to an ingress device of the second label switched domain over the non-label switched domain;

encapsulating the label switched packet by the egress device of the first label switched domain;

10 forwarding the encapsulated label switched packet by the egress device of the first label switched domain over the tunnel to the ingress device of the second label switched domain;

decapsulating the encapsulated label switched packet by the ingress device of the second label switched domain; and

forwarding the decapsulated label switched packet by the ingress device of the second label switched domain based upon label switching information in the packet.

47. A communication system according to claim 46, wherein the first label switched domain is a MPLS domain and the second label switched domain is a MPLS domain.

48. A communication system according to claim 46, wherein the tunnel is an IP tunnel.

49. A communication system according to claim 48, wherein the IP tunnel is a Generic Routing Encapsulation (GRE) tunnel.

25 50. A tunneling protocol for interconnecting a first label switched domain and a second label switched domain, the tunneling protocol comprising:

encapsulation means for encapsulating a payload packet from a label switched protocol; and

a protocol type indicator for identifying the label switched protocol.

30 51. A tunneling protocol according to claim 50, wherein the label switched protocol is MPLS.

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52. A tunneling protocol according to claim 50, wherein the tunneling protocol is a modified Generic routing Encapsulation (GRE) protocol.

5 53. A communication system comprising a first label switched domain having an egress device, a second label switched domain having an ingress device and a non-label switched domain which couples the egress device of the first label switched domain to the ingress device of the second label switched domain, wherein a label switched path for forwarding a packet and label stack is established by

10 establishing a tunnel from an egress device of the first label switched domain to an ingress device of the second label switched domain over the non-label switched domain;

encapsulating the packet and label stack by the egress device of the first label switched domain;

forwarding the encapsulated packet and label stack by the egress device of the first label switched domain over the tunnel to the ingress device of the second label switched domain;

decapsulating the encapsulated packet and label stack by the ingress device of the second label switched domain; and

forwarding the decapsulated packet and label stack by the ingress device of the second label switched domain based upon label switching information in the packet.

54. A communication system according to claim 53, the first label switched domain is a MPLS domain and the second label switched domain is a MPLS domain.

25 55. A communication system according to claim 53, wherein the tunnel is an IP tunnel.

56. A communication system according to claim 55, wherein the IP tunnel is a Generic Routing Encapsulation (GRE) tunnel.

30 57. A communication system comprising:

a first label switched domain for forwarding a label switched packet, the first label switched domain having a plurality of label switching devices including an egress device;



a second label switched domain for forwarding the label switched packet, the second label switched domain having a plurality of label switching devices including an ingress device; and

a non-label switched domain having a plurality of forwarding devices, the non-label switched domain coupling the egress device of the first label switched domain to the ingress device of the second label switched domain; wherein:

the egress device establishes a tunnel from the first label switched domain to the ingress device of the second label switched domain across the non-label switched domain;

the egress device encapsulates the label switched packet;

the egress device forwards the encapsulated label switched packet over the tunnel to the ingress device of the second label switched domain;

the ingress device receives the encapsulated label switched packet from the tunnel;

the ingress device decapsulates the encapsulated label switched packet; and

the ingress device forwards the decapsulated label switched packet based on label switching information in the packet.

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